CLAIMS

1. A seamless tubular polyimide film, comprising polyimide
having at least two aromatic tetracarboxylic acid components
5   having a mixture of 15 to 55 mol% of asymmetric aromatic
tetracarboxylic acid component and 85 to 45 mol% of symmetric
aromatic tetracarboxylic acid component and at least one
aromatic diamine component, the seamless tubular polyimide
film having a yield stress (σ_Y) of at least 120 MPa and
10   having a tensile strength to yield stress stress ratio
(σ_{cr}/σ_Y) of at least 1.10.

2. A semi-conductive seamless tubular polyimide film,
wherein
15   carbon black is dispersed in polyimide having at least
two aromatic tetracarboxylic acid components having a mixture
of 15 to 55 mol% of asymmetric aromatic tetracarboxylic acid
component and 85 to 45 mol% of symmetric aromatic
tetracarboxylic acid component and at least one aromatic
20   diamine component, the semi-conductive seamless tubular
polyimide film having a surface resistivity of 10^3 to 10^{15}
Ω/sq.

3. A semi-conductive seamless tubular polyimide film
25   according to Claim 2, wherein
        a log standard deviation of surface resistivity is 0.2
or smaller,
        a log standard deviation of volume resistivity is 0.2
or smaller, and
30   a difference between a log surface resistivity and a
log volume resistivity is 0.4 or smaller.

4. A method for producing a seamless tubular polyimide film,
comprising:
35   rotationally molding a mixed solution substantially in

a monomeric state having a mixture of an aromatic tetracarboxylic acid component comprising 15 to 55 mol% of asymmetric aromatic tetracarboxylic acid and/or ester thereof and 85 to 45 mol% of symmetric aromatic tetracarboxylic acid

5   and/or ester thereof and an approximately equimolar amount of an aromatic diamine component, to form a tubular shape, and

imidizing the tubular material by heating.

5. A method for producing a semi-conductive seamless tubular

10   polyimide film, comprising:

mixing an aromatic tetracarboxylic acid component comprising 15 to 55 mol% of asymmetric aromatic tetracarboxylic acid and/or ester thereof and 85 to 45 mol% of symmetric aromatic tetracarboxylic acid and/or ester

15   thereof and an approximately equimolar amount of an aromatic diamine component, to form mixed solution substantially in a monomeric state,

dispersing 1 to 35 parts by weight of carbon black in the mixed solution, per 100 parts by weight of a total amount

20   of the aromatic tetracarboxylic acid component and the aromatic diamine component, to form a semi-conductive monomer mixed solution,

rotationally molding the semi-conductive monomer mixed solution to form a tubular shape; and

25   imidizing the tubular material by heating.

6. A semi-conductive seamless tubular polyimide film for use in an intermediate transfer belt in an electrophotographic system produced by a production method of Claim 5.

30   7.   A semi-conductive aromatic amic acid composition comprising:

an aromatic amic acid oligomer obtained by polycondensation of at least two aromatic tetracarboxylic acid derivatives and an approximately equimolar amount of at

35   least one aromatic diamine;

carbon black; and

an organic polar solvent.

8. A semi-conductive aromatic amic acid composition according to Claim 7, wherein the aromatic amic acid oligomer is obtained by polycondensation of at least two aromatic tetracarboxylic dianhydrides and an approximately equimolar amount of said at least one aromatic diamine in an organic polar solvent at about 80°C or lower.

9. A semi-conductive aromatic amic acid composition according to Claim 8, wherein said at least two aromatic tetracarboxylic dianhydrides are 15 to 55 mol% of asymmetric aromatic tetracarboxylic dianhydride and 85 to 45 mol% of symmetric aromatic tetracarboxylic dianhydride.

10. A semi-conductive aromatic amic acid composition according to Claim 7, wherein the aromatic amic acid oligomer is obtained by polycondensation of at least two aromatic tetracarboxylic acid diesters and an approximately equimolar amount of said at least one aromatic diamine in an organic polar solvent at about 90 to about 120°C.

11. A semi-conductive aromatic amic acid composition according to Claim 10, wherein said at least two aromatic tetracarboxylic acid diesters are 15 to 55 mol% of asymmetric aromatic tetracarboxylic acid diester and 85 to 45 mol% of symmetric aromatic tetracarboxylic acid diester.

12. A semi-conductive aromatic amic acid composition according to Claim 7, wherein a number average molecular weight of the aromatic amic acid oligomer is about 1000 to about 7000.

13. A semi-conductive aromatic amic acid composition

according to Claim 7, wherein carbon black is present in an amount of about 3 to about 30 parts by weight per 100 parts by weight of a total amount of aromatic tetracarboxylic acid component and organic diamine.

14.   A method for producing a semi-conductive seamless tubular polyimide film, comprising:

rotationally molding a semi-conductive aromatic amic acid composition according to Claim 7; followed by heating.

15.   A semi-conductive seamless tubular polyimide film for use in an intermediate transfer belt in an electrophotographic system produced by a production method according to Claim 14.

16.   A method for producing a semi-conductive aromatic amic acid composition comprising:

subjecting at least two aromatic tetracarboxylic acid derivatives and an approximately equimolar amount of at least one aromatic diamine to partial condensation polymerization in an organic polar solvent, thereby yielding an aromatic amic acid oligomer solution; and

uniformly mixing electrically conductive carbon black powder with the oligomer solution.

17.   A semi-conductive polyimide-based precursor composition, wherein carbon black is uniformly dispersed in a mixed solution prepared by mixing a high-molecular-weight polyimide precursor solution or high-molecular-weight polyamideimide solution in a nylon salt monomer solution in which at least two aromatic tetracarboxylic acid diesters and an approximately equimolar amount of at least one aromatic diamine are dissolved in an organic polar solvent.

18.   A semi-conductive polyimide-based precursor composition

according to Claim 17, wherein said at least two aromatic tetracarboxylic acid diesters are 10 to 55 mol% of asymmetric aromatic tetracarboxylic acid diester and 90 to 45 mol% of symmetric aromatic tetracarboxylic acid diester.

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19. A semi-conductive polyimide-based precursor composition according to Claim 17, wherein said at least two aromatic tetracarboxylic acid diesters are 10 to 55 mol% of asymmetric 2,3,3',4'-biphenyl tetracarboxylic acid diester and 90 to 45

10 mol% of symmetric 3,3',4,4'-biphenyl tetracarboxylic acid diester.

20. A semi-conductive polyimide-based precursor composition according to Claim 17, wherein the high-molecular-weight

15 polyimide precursor solution is a polyamic acid solution whose number average molecular weight is 10000 or larger and the high-molecular-weight polyamideimide solution is a polyamideimide solution whose number average molecular weight is 10000 or larger.

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21. A semi-conductive polyimide-based precursor composition according to Claim 20, wherein the polyamic acid solution whose number average molecular weight is 10000 or larger is produced by reaction of diaminodiphenyl ether and an

25 approximately equimolar amount of biphenyltetracarboxylic dianhydride in an organic polar solvent.

22. A semi-conductive polyimide-based precursor composition according to Claim 20, wherein the polyamideimide solution

30 whose number average molecular weight is 10000 or larger is produced by reaction of acid anhydride comprising trimellitic acid anhydride and benzophenone tetracarboxylic dianhydride and an approximately equimolar amount of aromatic isocyanate in an organic polar solvent.

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23.   A method for producing a semi-conductive seamless tubular polyimide film, comprising:

   rotationally molding a semi-conductive polyimide-based precursor composition according to Claim 17, to form a tubular shape; and

   imidizing the tubular material by heating.

24.   A semi-conductive seamless tubular polyimide-based film for use in an intermediate transfer belt in an electrophotographic system produced by a production method according to Claim 23, whose surface resistivity is 10^7 to 10^{14} Ω/sq.

25.   A method for producing a semi-conductive polyimide-based precursor composition, comprising:

   mixing a high-molecular-weight polyimide precursor solution or high-molecular-weight polyamideimide solution in a nylon salt monomer solution in which at least two aromatic tetracarboxylic acid diesters and an approximately equimolar amount of at least one aromatic diamine are dissolved in an organic polar solvent to prepare a mixed solution, and

   uniformly dispersing carbon black in the mixed solution.

26.   A method for producing a high-concentration semi-conductive polyimide precursor composition, comprising:

   uniformly dispersing carbon black in an organic polar solvent to give a carbon black dispersion and

   dissolving aromatic tetracarboxylic acid diester and an approximately equimolar amount of aromatic diamine in the carbon black dispersion.

27.   A method for producing a high-concentration semi-conductive polyimide precursor composition according to Claim 26, wherein the aromatic tetracarboxylic acid diester is a mixture of 10 to 55 mol% of asymmetric aromatic

tetracarboxylic acid diester and 90 to 45 mol% of symmetric aromatic tetracarboxylic acid diester.

28. A method for producing a high-concentration semi-conductive polyimide precursor composition according to Claim 26, wherein the aromatic tetracarboxylic acid diester is a mixture of 10 to 55 mol% of asymmetric 2,3,3′,4′-biphenyl tetracarboxylic acid diester and 90 to 45 mol% of symmetric 3,3′,4,4′-biphenyl tetracarboxylic acid diester.

29. A method for producing a high-concentration semi-conductive polyimide precursor composition according to Claim 26, wherein carbon black is present in an amount of 5 to 35 parts by weight per 100 parts by weight of a total amount of the aromatic tetracarboxylic acid and the aromatic diamine.

30. A high-concentration semi-conductive polyimide precursor composition produced by a production method of Claim 26.

31. A method for producing a semi-conductive seamless tubular polyimide film, comprising:

rotationally molding a high-concentration semi-conductive polyimide precursor composition according to Claim 30, to form a tubular shape; and

imidizing the tubular material by heating.

32. A semi-conductive seamless tubular polyimide film for use in an intermediate transfer belt in an electrophotographic system produced by a method according to Claim 31, whose surface resistivity is 10^7 to 10^{14} Ω/sq.